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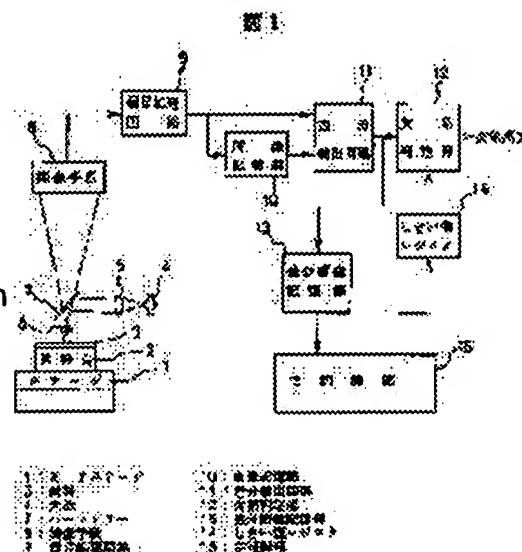
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(54) VISUAL INSPECTION SYSTEM AND VISUAL INSPECTION METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a visual inspection technology in which a threshold can be set easily and accurately.

SOLUTION: With regard to two adjacent chips of a semiconductor wafer, image signal of a left chip is picked up, at first, by an image pickup means 8 with a specified inspection width and processed by a signal processing circuit 9 before being stored in an image storing section 10. Subsequently, image signal of a right chip is picked up with the same inspection width and processed by the signal processing circuit 9 before being delivered to a difference detection circuit 11 without being stored in the image storing section 10. The difference detection circuit 11 compares two image signals and if the difference is larger than a specified value, a defect judging section 12 judges the chip defective based on the difference signal and the optimal threshold of a threshold register 14.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the technique which uses in order to conduct automatically the technique of inspecting the appearance of the front face of bodies, such as a semi-conductor wafer, and visual inspection in the production process of a semiconductor device, and is effective especially.

[0002]

[Description of the Prior Art] For example, it faces [mass-producing LSI (large-scale integrated circuit) and], and the improvement in the yield of wafer down stream processing which forms a semiconductor device poses a problem most. The appearance of almost all the causes of this yield lowering is poor, and this reduction has been an important technical problem. For this reason, automation of wafer visual inspection is needed.

[0003] by the way, this invention person -- visual inspection, such as a semi-conductor wafer, a substrate, a mask, reticle, and liquid crystal; -- difference -- the problem of setting out of the threshold in the case of carrying out using value processing was examined.

[0004] The following is the technique examined by this invention person, and the outline is as follows.

[0005] the difference which picturized the chip to be examined with the television camera etc., for example, and compared and obtained the image pattern of two chips in the image processing for this kind of visual inspection -- using the value, further, a threshold is set up and the defective judging is performed.

[0006] as the approach of setting up a threshold -- for example, the difference of an image -- it asks for area and the approach of setting up a threshold automatically according to change of the maximum area, the method of setting up a threshold based on the incorrect detection ratio of the normal pattern section, etc. are learned.

[0007] In addition, when a subject of examination is a semi-conductor wafer, the variation of tolerance (difference in the width of face of the pattern of precision dispersion of a product, for example, the stratification phase of a chip, etc.) of the pattern of the slight oscillation in the case of migration of the X-Y stage which carried the semi-conductor wafer, and a semi-conductor wafer etc. causes incorrect detection. For this reason, detection sensitivity is determined and it is necessary to determine a threshold in consideration of mechanical precision and product precision with mechanical precision and product precision.

[0008]

[Problem(s) to be Solved by the Invention] however -- like the above -- difference -- the maximum area of area by the approach of making it into a decision standard When the defect is included in the input image point, since a defective part is detected as the maximum area, a threshold cannot be calculated. Moreover, by the approach of setting up a threshold based on the incorrect detection ratio of the normal pattern section, the consideration about a point which identifies the normal pattern section in which a defect is not included was not made, but it was found out by this invention person that there is a problem that the existence of a defect must be checked by viewing.

[0009] Then, the object of this invention is to offer the visual-inspection technique in which a threshold can be set up simply and exactly.

[0010] Said object of this invention and the new description will become clear from description and the accompanying drawing of this description.

[0011]

[Means for Solving the Problem] It will be as follows if the outline of a typical thing is briefly explained among invention indicated in this application.

[0012] Namely, a means to detect each image of two or more patterns formed so that it might become the same [the visual-inspection equipment of this invention / an inspected lifter], It is visual-inspection equipment equipped with a

means to judge the defect of a pattern based on a value and a threshold. the difference between the detected images -- the difference between the images in two or more points of an inspected lifter -- it has a means to determine the threshold which makes a defect the normal section with pattern variation of tolerance, and does not incorrect-detect it, using the information on the standard deviation of a value.

[0013] moreover, the difference between the images which detected and detected each image of two or more patterns formed so that it might become the same [the visual-inspection approach of this invention / an inspected lifter] -- the difference between images [in / it is the visual-inspection approach of judging the defect of a pattern based on a value and a threshold, and / two or more points of an inspected lifter] -- the threshold which makes a defect the normal section with pattern variation of tolerance, and does not incorrect-detect it determines using the information on the standard deviation of a value.

[0014] according to the above-mentioned means -- the difference of two or more points of an inspected lifter -- the threshold determined based on the statistic of amount data can be used as central value which can set up as a near decision value of the optimal threshold, or serves as criteria. Therefore, it becomes possible to set the optimal defective detection threshold as automatic and a short time.

[0015]

[Embodiment of the Invention] (Example 1) Drawing 1 is the block diagram showing one example of the automatic visual-inspection equipment by this invention.

[0016] The sample base 2 is attached in the top face of X-Y stage 1 movable free in the direction of X, and the direction of Y, and a sample (semi-conductor wafer) 3 is set on this sample base. On the other hand, in order to illuminate the front face of the sample 3 which is an inspected object, the light source 4 is established, and the condenser lens 5 is arranged on the optical path.

[0017] An objective lens 6 is arranged in the upper part of a sample 3, it is this upper part and the half mirror 7 is arranged on the outgoing radiation optical path of a condenser lens 5. Furthermore, the image pick-up means 8 is arranged in the focus location of an objective lens 6. This image pick-up means 8 carries out photo electric translation of the reflected light from a sample 3, and is constituted using a single dimension line sensor or a two-dimensional ITV (industrial television) camera. The digital disposal circuit 9 for performing magnification, distortion amendment, A/D conversion, etc. is connected to the image pick-up means 8 in that picture signal, and the image storage section 10 for memorizing the digitized picture signal is connected to this digital disposal circuit 9.

[0018] the difference which detects the difference between the output signal of the image storage section 10, and the output signal of a digital disposal circuit 9 in a digital disposal circuit 9 -- a detector 11 connects -- having -- this difference -- the defective judging section 12 which judges the defect on a pattern is connected to the detector 11.

[0019] difference -- the subtraction-image storage section 13 which memorizes the detection result is connected to a detector 11, and the threshold register 14 which memorizes a threshold is connected to the defective judging section 12 in it. furthermore, the difference of the subtraction-image storage section 13 -- in order to choose the threshold of the threshold register 14 based on data, the main control section 15 which used the microcomputer etc. is formed.

[0020] In the above configuration, in order to conduct visual inspection, first, a sample 3 is laid on the sample base 2, and the light source 4 is turned on. The output light from the light source 4 reaches a half mirror 7 through a condenser lens 5, and reaches on a sample 3 through an objective lens 6 further. The reflected light of the lighting part of a sample 3 passes a half mirror 7, and carries out image formation of the pattern to the image pick-up means 8. After carrying out signal processing of the picture signal by which photo electric translation was carried out with the image pick-up means 8 by the digital disposal circuit 9, it is temporarily memorized by the image storage section 10.

[0021] the picture signal of the present chip by which the direct output was carried out from the picture signal and digital disposal circuit 9 of other chips memorized by this image storage section 10 -- difference -- it is compared by the detector 11, the difference of both picture signals is taken, and that differential signal is memorized by the subtraction-image storage section 13.

[0022] the difference the main control section 15 is remembered to be by the subtraction-image storage section 13 -- the optimal threshold is calculated based on data and a threshold is set as the threshold register 14.

[0023] the defective judging section 12 -- difference -- a defective output will be performed, if a defect is judged based on the differential signal from a detector 11, and the optimal threshold set as the threshold register 14 and it is judged with a defect.

[0024] Next, a semi-conductor wafer is taken for an example and how to detect a defect is explained.

[0025] Drawing 2 is the top view showing the configuration of a semi-conductor wafer. As for the semi-conductor wafer which is a sample 3, much chip 3b is arranged in the shape of a grid at one side of disc-like silicon substrate 3a.

[0026] When single dimension line sensors, such as CCD (charge-coupled device), are used for the image pick-up

means 8 as opposed to the sample 3 which consists of such a semi-conductor wafer, as shown in drawing 3, to adjoining two chip 3b, first, a picture signal A is incorporated by the inspection width of face W_r , and left-hand side chip 3b is stored in the image storage section 10 after processing processing according this to a digital disposal circuit 9. subsequently -- after picturizing right-hand side chip 3b as a picture signal B with the same inspection width of face W_D and carrying out signal processing by the digital disposal circuit 9, without it stores in the image storage section 10 -- difference -- it sends out to a detector 11. difference -- in a detector 11, two picture signals (slash section) of drawing 3 are compared, and when the difference is more than fixed, based on the differential signal and optimal threshold of the threshold register 14, a defect is judged by the defective judging section 12.

[0027]